

Modeling Emissions for Air Pollution Permits

SB-116 2019

Any facility engaging in activities that cause air pollution may need an air pollution permit from Wisconsin Department of Natural Resources (DNR). Refer to the fact sheets from Small Business Environmental Assistance Program (SBEAP) on permits if you think you might need a permit. DNR cannot approve a permit if emissions from a facility (or "source") exceed any National Ambient Air Quality Standard (NAAQS).

The US Environmental Protection Agency (EPA) sets the NAAQS for all criteria pollutants, and DNR enforces those standards in Wisconsin. The NAAQS are set to protect human health and welfare concerns. Criteria pollutants are specific compounds that EPA has determined cause human health and welfare concerns at specific levels. Those levels form the basis for the NAAQS. To make sure emissions from a facility meet the NAAQS, each permit review includes running a computer model that predicts impacts from that facility.

DNR Models Emissions from a Single Facility

EPA has approved specific computer models used to quantify impact caused by emissions from a single business. Computer models required for permitting are quite complex. Copies of these computer programs are available on EPA's web site at: <https://www.epa.gov/air-emissions-modeling>.

DNR modelers use the AERMOD software. To use this program the modeler enters:

1. the facility configuration, including stack locations, buildings, and fence lines (where applicable) as if laid out in a grid,
2. values for emissions rates of specific criteria pollutants (PM, NO_x, SO₂, CO) from each stack, and
3. meteorological data such as wind direction and speed, to show where the pollutants will disperse.

The computer model completes very complex calculations and determines the point on the ground where the highest impact from one pollutant emitted from all the stacks combined will be found. This impact is the concentration of the pollutant from the business that a person standing at the impact point would take in by breathing.

Certain levels of each criteria pollutant exist in the air at all times. Monitors throughout the state have measured the levels of pollutants in the air, and DNR calls this existing level of criteria pollutants the "background" concentration. The modeler adds the impact from the facility, as calculated by the model, with the amount of a criteria pollutant contained in background concentration to calculate a total impact.

The total impact is the level of pollution experienced by a person standing at the point of impact. The model calculates the impact for each hour and the results are averaged over a specific time period (i.e., 3-hour average). This averaged value is compared against the relevant NAAQS to see whether the facility meets the standard. A person standing at the point of highest impact for 3 hours and breathing in an average concentration of 0.5 PPM of SO₂ per hour for all three hours may experience irritation of the eyes and nose.



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Each of the NAAQS is based on the level of impact of a criteria pollutant that causes health effects in the environment or in humans when averaged over a certain period of time. Some pollutants are a concern at lower levels over a very long period of time (averaged over a whole year, for example), while others are of concern at higher levels for very short periods of time (1-hour average). Some have multiple levels of concern.

The current NAAQS for each criteria pollutant are listed in the table to the right. For the most current values, go to: <https://www.epa.gov/criteria-air-pollutants/naaqs-table>.

Modeled Emissions above the NAAQS

Permit applications require a facility to provide DNR with a plot map, drawn to scale, and emissions rates for all stacks included in the application. Related portions of a permit application are passed from the permit writer to a DNR modeler. Computer modeling is performed by the modeler and the results sent to the permit writer. If the total impact of the emissions is greater than NAAQS levels, the permit writer and modeler discuss the options. Some options are easily dealt with by DNR, while others require input by the facility.

Limitations on Operations

In the past, the modeling process might start by using the maximum theoretical emissions (MTE) or potential to emit (PTE) -- for more information on these emissions rate definitions see the SBEAP fact sheet MTE and PTE Calculation Examples (<https://dnr.wi.gov/files/pdf/pubs/sb/sb113.pdf>).

Because the new version of AERMOD is more accurate and the NAAQS are lower, those emissions levels rarely pass. A facility will need to ask for specific limitations in the permit to set the modeling emissions level, to determine whether the impact is sufficiently limited to be less than the NAAQS. Some limitations that may be used are restrictions on:

- ⇒ raw material use;
- ⇒ hours of operation;
- ⇒ a certain level of control via a control device (i.e., 90% control by baghouse for PM).

Pollutant	NAAQS
Sulfur Dioxide (SO ₂)	75 PPB, 99%, 1-hour daily max, 3-year average
	0.5 PPM, 3-hour average
Fine Particulate Matter (PM _{2.5})	12 µg/m ³ , annual mean, 3-year average
	35 µg/m ³ , 24-hour, 98% 3-year average
Fine Particulate Matter (PM ₁₀)	150 µg/m ³ , 24-hour, not to be exceeded more 1/year, on 3-year average
Carbon Monoxide (CO)	9 PPM, 8-hour average
	35 PPM, 1-hour average
Nitrogen Oxides (NO _x)	53 PPB, annual average
	100 PPB, 1-hour, 98% 1-hour daily maximum, 3-year average
NOTE: The units for the NAAQS are in "micrograms (µg) of the pollutant per cubic meter (m ³) of air" where a microgram is 1/1000 of 1/1000 of a gram, PPM (parts per million), or PPB (parts per billion). A measure of "weight of material per volume of air" is also called the concentration of that pollutant in the air. The concentration of a pollutant at ground level, where people can breathe it, is called the impact level. The total impact calculated from the business' emissions is then averaged over the specified time periods (i.e., 24-hour average) and compared against the NAAQS level.	

Often very restrictive limits must be applied for pollutants having standards with short-term averages. For example, a facility exceeding the 3-hour SO₂ standard would probably need to propose limiting a raw material to a 3-hour cap on usage (i.e., no more than 10 gallons of fuel every 3 hours).

No matter why a limitation is established, the facility must formally request, in writing, that the related conditions be put in its permit.

Stack Parameters

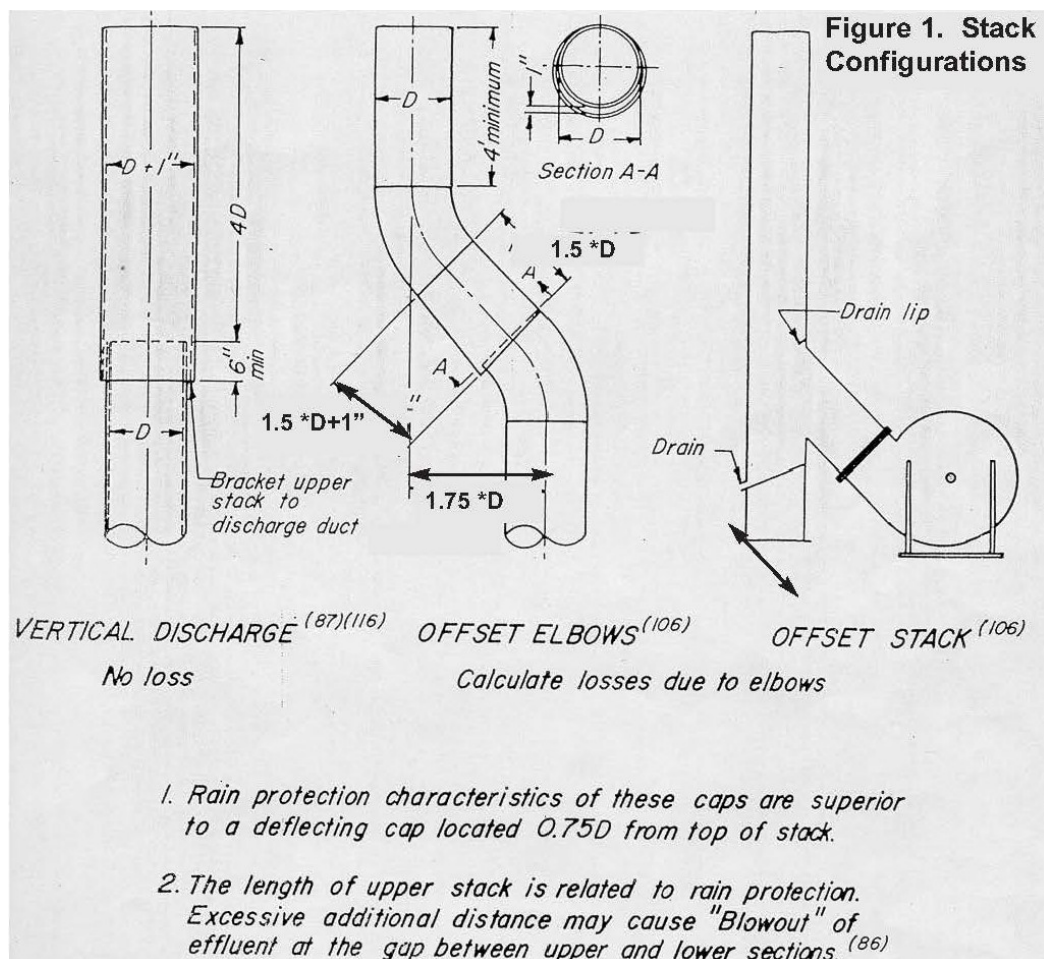
One quick option that may enable a facility to meet NAAQS is to change the type of rain diversion equipment installed at the top of a stack. Often facilities have "rainhats" fixed just above and completely covering the area above the stack opening. These rainhats push the exhaust down towards the ground and can result in very high impacts close to the buildings from which the stacks exhaust.

Three stack configuration options (see Figure 1) both divert rain from going down the stack and direct discharge of exhaust gases up into the air. Facility operators should review these stack configurations and decide which best meets exhaust and emissions needs. If one of these three can be used, DNR can run the model again to determine if impact is reduced.

Another option is to increase stack height and/or decrease stack diameter. These changes to stack design will allow pollution to be released higher and pulled farther from the building before descending to the ground. Impact at ground level is thereby reduced. This option will require more input from the owner or operator of the facility. A consultant may be needed to run the model a number of times to achieve the right mix of stack heights and diameters. DNR will perform a few model runs for each permit, but application backlogs limit the number of model runs for a single permit. Often engineers must be consulted to determine a safe stack height.

Permit Requirements

Once the methods necessary to meet the NAAQS are established, DNR will include those elements in the permit as "enforceable conditions." Because multiple options exist to allow a facility to meet the NAAQS, an amendment to the initial permit application must be submitted by the owner/operator requesting that specific limits be included in the permit. DNR can only make suggestions about available options. Once the facility owner/operation elects a compliance option, the permit writer can then include it in the permit.



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